apprenticeship program is more structured. Apprentices also learn to dampproof and waterproof walls.

Good physical condition and good balance are essential for roofers. A high school education or its equivalent is helpful, as are courses in mechanical drawing and basic mathematics. Most apprentices are at least 18 years old.

Roofers may advance to supervisor or estimator for a roofing contractor, or become contractors themselves.

Job Outlook

Jobs for roofers should be plentiful through the year 2008, primarily because of the need to replace workers who transfer to other occupations or leave the labor force. Turnover is high—roofing work is hot, strenuous, and dirty, and a significant number of workers treat roofing as a temporary job until something better comes along. Some roofers leave the occupation to go into other construction trades.

Employment of roofers is expected to grow about as fast as the average for all occupations through the year 2008. Roofs deteriorate faster than most other parts of buildings and periodically need to be repaired or replaced. About 75 percent of roofing work is repair and reroofing, a higher proportion than in most other construction work. As a result, demand for roofers is less susceptible to downturns in the economy than some of the other construction trades. In addition to repair and reroofing work on the growing stock of buildings, new construction of industrial, commercial, and residential buildings will add to the demand for roofers. However, many innovations and advances in materials, techniques, and tools have made roofers more productive than before and will restrict the growth of employment—at least to some extent. Jobs should be easiest to find during spring and summer, when most roofing is done.

Earnings

In 1998, median hourly earnings of roofers were $12.18. The middle 50 percent earned between $9.72 and $16.47. The lowest 10 percent earned less than $7.56 and the highest 10 percent earned more than $21.77.

Some roofers are members of the United Union of Roofers, Waterproofers & Allied Workers. According to the limited information available, average hourly earnings—including benefits—for roofers who belonged to a union and worked full time, ranged between $15.30 and $41.20 in 1998. Roofers in New York, Boston, San Francisco, Chicago, Los Angeles, Philadelphia, and other large cities received the highest wages.

Apprentices usually start at about 40 percent of the rate paid to experienced roofers and receive periodic raises as they acquire the skills of the trade. Earnings for roofers are reduced on occasion because poor weather often limits the time they can work.

Related Occupations

Roofers use shingles, bitumen and gravel, single-ply plastic or rubber sheets, or other materials to waterproof building surfaces. Workers in other occupations who cover surfaces with special materials for protection and decoration include carpenters, cement masons, concrete finishers, drywall installers and finishers, floor covering installers, plasterers and stucco masons, terrazzo workers, and tilesetters.

Sources of Additional Information

For information about roofing apprenticeships or job opportunities in this trade, contact local roofing contractors; a local chapter of the roofers union; a local joint union-management apprenticeship committee; or the nearest office of your State employment service or State apprenticeship agency.

For information about the work of roofers, contact:

☛ National Roofing Contractors Association, 10255 W. Higgins Rd., Rosemont, IL 60018-5607

☛ United Union of Roofers, Waterproofers and Allied Workers, 1660 L St. NW., Suite 800, Washington, DC 20036.

Sheet Metal Workers and Duct Installers

(O*NET 89132)

Significant Points

- Job prospects should be good for persons who complete apprenticeship programs.
- Sheet metal work tends to be steadier than some other construction crafts, because maintenance and replacement work in existing buildings can compensate for slack in new construction.
- Unlike most construction craft occupations, few sheet metal workers and duct installers are self-employed.

Nature of the Work

Sheet metal workers and duct installers make, install, and maintain air-conditioning, heating, ventilation, and pollution control duct systems; roofs; siding; rain gutters; downspouts; skylights; restaurant equipment; outdoor signs; and many other building parts and products made from metal sheets. They may also work with fiberglass and plastic materials. Although some workers specialize in fabrication, installation, or maintenance, most do all three jobs. (Workers employed in the mass production of sheet metal products in manufacturing are not included in this statement.)

Sheet metal workers usually fabricate their products at a shop away from the construction site. They first study plans and specifications to determine the kind and quantity of materials they will need. They then measure, cut, bend, shape, and fasten pieces of sheet metal to make duct work, counter tops, and other custom products. In an increasing number of shops, sheet metal workers use computerized metalworking equipment. This enables them to experiment with different layouts and to select the one that results in the least waste of material. They cut or form parts with computer-controlled saws, lasers, shears, and presses.

In shops without computerized equipment, and for products that cannot be made on such equipment, sheet metal workers use hand calculators to make the required calculations and use tapes, rulers, and other measuring devices for layout work. They then cut or stamp the parts on machine tools.

Before assembling pieces, sheet metal workers check each part for accuracy and, if necessary, finish it by using hand, rotary, or squaring

Sheet-metal workers usually fabricate their products at a shop away from the construction site.

shears and hacksaws. After the parts have been inspected, workers fasten seams and joints together with welds, bolts, cement, rivets, solder, specially formed sheet metal drive clips, or other connecting devices. They then take the parts to the construction site where they further assemble the pieces as they install them. These workers install ducts, pipes, and tubes by joining them end to end and hanging them with metal hangers secured to a ceiling or a wall. They also use shears, hammers, punches, and drills to make parts at the work site or to alter parts made in the shop.

Some jobs are done completely at the job site. When installing a metal roof, for example, sheet metal workers measure and cut the roofing panels that are needed to complete the job. They secure the first panel in place and interlock and fasten the grooved edge of the next panel into the grooved edge of the first. Then they nail or weld the free edge of the panel to the structure. This two-step process is repeated for each additional panel. Finally, they fasten machine-made molding at joints, along corners, and around windows and doors for a neat, finished effect.

In addition to installation, some sheet metal workers specialize in testing, balancing, adjusting, and servicing existing air-conditioning and ventilation systems to make sure they are functioning properly and to improve their energy efficiency.

Working Conditions

Sheet metal workers and duct installers usually work a 40-hour week. Those who fabricate sheet metal products work in shops that are well-lighted and well-ventilated. However, they stand for long periods and lift heavy materials and finished pieces. Sheet metal workers must follow safety practices because working around high-speed machines can be dangerous. They are also subject to cuts from sharp metal, burns from soldering and welding, and falls from ladders and scaffolds. They usually wear safety glasses but must not wear jewelry or loose-fitting clothing that could easily be caught in a machine.

Those doing installation work do considerable bending, lifting, standing, climbing, and squatting, sometimes in close quarters or in awkward positions. Although installing duct systems and kitchen equipment is done indoors, the installation of siding, roofs, and gutters involves much outdoor work, requiring sheet metal workers to work in various kinds of weather.

Employment

Sheet metal workers and duct installers held about 122,000 jobs in the construction industry in 1998. Nearly three-fourths worked for plumbing, heating, and air-conditioning contractors; most of the rest worked for roofing and sheet metal contractors. Some worked for other special trade contractors and for general contractors engaged in residential and commercial building. Unlike many other construction trades, few sheet metal workers are self-employed.

Jobs for sheet metal workers are distributed throughout the country in about the same proportion as the total population.

Training, Other Qualifications, and Advancement

Sheet metal contractors consider apprenticeship the best way to learn this trade. The apprenticeship program consists of 4 or 5 years of on-the-job training and a minimum of 144 hours per year of classroom instruction. Apprenticeship programs provide comprehensive instruction in both sheet metal fabrication and installation. They are administered by local joint committees composed of the Sheet Metal Workers' International Association, local chapters of the Sheet Metal and Air-Conditioning Contractors National Association.

On the job, apprentices learn the basics of pattern layout and how to cut, bend, fabricate, and install sheet metal. They begin with basic ductwork and gradually advance to more difficult jobs, such as making more complex ducts, fittings, and decorative pieces. They also use materials such as fiberglass, plastics, and other non-metallic materials.

In the classroom, apprentices learn drafting, plan and specification reading, trigonometry and geometry applicable to layout work, the use of computerized equipment, welding, and the principles of heating, air-conditioning, and ventilating systems. Safety is stressed throughout the program. In addition, apprentices learn the relationship between sheet metal work and other construction work.

A relatively small number of persons pick up the trade informally, usually by working as helpers to experienced sheet metal workers. Most begin by carrying metal and cleaning up debris in a metal shop while they learn about materials and tools and their uses. Later, they learn to operate machines that bend or cut metal. In time, helpers go out on the job site to learn installation. Those who acquire their skills this way often take vocational school courses in mathematics or sheet metal fabrication to supplement their work experience. To be promoted to the journey level, helpers usually must pass the same written examination as apprentices.

Applicants for jobs as apprentices or helpers should be in good physical condition and have mechanical and mathematical aptitude. Good eye-hand coordination, spatial and form perception, and manual dexterity are also important. Local apprenticeship committees require a high school education or its equivalent. Courses in algebra, trigonometry, geometry, mechanical drawing, and shop provide a helpful background for learning the trade, as does related work experience obtained in the Armed Services.

It is important for experienced sheet metal workers to keep abreast of new technological developments, such as the growing use of computerized layout and laser cutting machines. Workers often take additional training provided by the union or by their employer, to improve existing skills or to acquire new ones.

Sheet metal workers and duct installers may advance to supervisory jobs. Some of these workers take additional training in welding and do work that is more specialized. Others go into the contracting business for themselves. Because a sheet metal contractor must have a shop with equipment to fabricate products, this type of contracting business is more expensive to start than other types of construction contracting.

Job Outlook

Job prospects are expected to be favorable for sheet metal workers and duct installers over the long run, because the number of skilled workers is likely to be insufficient to meet demand, due to job growth and the need to replace workers who leave the occupation. Opportunities should be particularly good for individuals who acquire apprenticeship training. Employment of sheet metal workers and duct installers in construction is expected to increase faster than the average for all occupations, reflecting growth in the demand for sheet metal installations as more industrial, commercial, and residential structures are built. Growing demand for additional energy-efficient air-conditioning, heating, and ventilation systems in the growing stock of old buildings, as well as other types of renovation and maintenance work, also should boost employment. In addition, the popularity of decorative sheet metal products and increased architectural restoration are expected to add to the demand for sheet metal workers and duct installers. Despite this growth in demand, most job openings will result from the need to replace workers who retire or leave the occupation for other reasons.

Workers may experience periods of unemployment, when construction projects end and economic conditions reduce the amount of construction activity. Because local economic conditions can vary widely, there can be shortages of experienced workers in some areas and an oversupply in other parts of the country. The availability of training slots also fluctuates with economic conditions, so the number of openings may vary from year to year and by geographic area. Nevertheless, employment of sheet metal workers and duct installers is less sensitive to declines in new construction than employment of some other construction workers, such as carpenters. Maintenance of existing equipment—which is less affected by economic fluctuations

than new construction—makes up a large part of the work done by sheet metal workers. Installation of new air-conditioning and heating systems in existing buildings continues during construction slumps, as individuals and businesses seek more energy-efficient equipment to cut utility bills. In addition, a large proportion of sheet metal installation and maintenance is done indoors, so these workers usually lose less work time due to bad weather than other construction workers do.

Earnings

In 1998, median hourly earnings of sheet metal workers and duct installers employed in all industries were $13.48. The lowest 10 percent of all sheet metal workers and duct installers earned less than $7.96 and the highest 10 percent earned more than $24.97. Sheet metal workers who work in the construction industry generally have the highest earnings.

According to the limited information available, average hourly earnings—including benefits—for sheet metal workers who belonged to a union and worked full time ranged between $19.20 and $49.40 in 1998.

Apprentices normally start at about 40 percent of the rate paid to experienced workers. As apprentices acquire more skills of the trade throughout the course of the apprenticeship program, they receive periodic increases until their pay approaches that of experienced workers. In addition, union workers in some areas receive supplemental wages from the union when they are on layoff or shortened workweeks. Almost 40 percent of all sheet metal workers and duct installers are members of the Sheet Metal Workers' International Association.

Related Occupations

To fabricate and install sheet metal products, sheet metal workers and duct installers combine metalworking skills and knowledge of construction materials and techniques. Other occupations in which workers lay out and fabricate metal products include layout workers, machinists, metal fabricators, metal patternmakers, shipfitters, and tool and die makers. Construction occupations requiring similar skills and knowledge include heating, air-conditioning, and refrigeration technicians, and glaziers.

Sources of Additional Information

For more information about apprenticeships or other work opportunities, contact local sheet metal contractors or heating, refrigeration, and air-conditioning contractors; a local of the Sheet Metal Workers; a local of the Sheet Metal and Air Conditioning Contractors National Association; a local joint union-management apprenticeship committee; or the nearest office of your State employment service or apprenticeship agency.

For general information about sheet metal workers and duct installers, contact:

☛ The International Training Institute , 601 N. Fairfax St., Suite 240, Alexandria, VA 22314.

☛ The Sheet Metal and Air Conditioning Contractors National Association, 4201 Lafayette Center Dr., Chantilly, VA 20151-1209.

☛ The Sheet Metal Workers International Association, 1750 New York Ave. NW., Washington, DC 20006.

Structural and Reinforcing Metal Workers

(O*NET 87314, 87814, and 91714)

Significant Points

- Structural and reinforcing metal workers earn high pay but often can't work during inclement weather.
- These workers are among the most likely to be put out of work when downturns in the economy slow new construction.
- Most people enter this occupation through a formal 3-year apprenticeship.

Nature of the Work

Builders use materials made from iron, steel, aluminum, fiberglass, precast concrete, brass, and bronze to construct highways, bridges, office and other large buildings, and power transmission towers. These structures have frames made of steel columns, beams, and girders. In addition, reinforced concrete—concrete containing steel bars or wire fabric—is an important material in buildings, bridges, and other structures, as the steel gives the concrete additional strength. Moreover, metal stairways, catwalks, floor gratings, ladders, and window frames—as well as lampposts, railings, fences, and decorative ironwork—increase these structures functionality and attractiveness. Structural and reinforcing metal workers fabricate, assemble, and install these metal products. They also repair, renovate, and maintain older buildings and structures, such as steel mills, utility plants, automobile factories, highways, and bridges.

Before construction can begin, metal workers must erect steel frames and assemble the cranes and derricks that move structural steel, reinforcing bars, buckets of concrete, lumber, and other materials and equipment around the construction site. The structural metal arrives at the construction site in sections. There, it is lifted into position by a mobile crane. Metal workers then connect the sections and set the cables to do the hoisting.

Once this job has been completed, *structural metal workers* begin to connect steel columns, beams, and girders according to blueprints and instructions from supervisors and superintendents. Structural steel, reinforcing rods, and ornamental iron generally come to the construction site ready for erection—cut to the proper size, with holes drilled for bolts and numbered for assembly. Metal workers do this pre-construction site work in fabricating shops usually located away from the construction site. In these fabrication shops, metal workers lay out the raw steel received from a steel mill and cut, bend, drill, bolt, and weld each piece according to the specifications for that particular job. Metal workers at the construction site unload and stack the fabricated steel so it can be hoisted easily when needed.

To hoist the steel, metal workers attach cables from a crane or derrick. One worker directs the hoist operator with hand signals. Another worker holds a rope (tag line) attached to the steel to prevent it from swinging. The crane or derrick hoists steel into place in the framework where several workers, using spud wrenches, position the steel with connecting bars and jacks. Workers using drift pins or the handle of a spud wrench—a long wrench with a pointed handle—align the holes in the steel with the holes in the framework. Then they temporarily bolt the piece in place; check vertical and

Reinforcing workers wire reinforcing bars.